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(54) Abstract Title
Bumper arrangement

(57) A bumper arrangement is described in which the bumper (3; 23; 303) comprises a plurality of bumper components arranged to form a motor vehicle bumper arrangement in normal vehicle use but present said bumper components in a collision plane CP upon percussive collision with a pedestrian leg (1; 21). Thus, the bumper components achieve a broad contact band with the pedestrian's leg (1; 21) which produces reduced bending of that leg (1; 21) in comparison with previous vehicle bumper arrangement configurations.

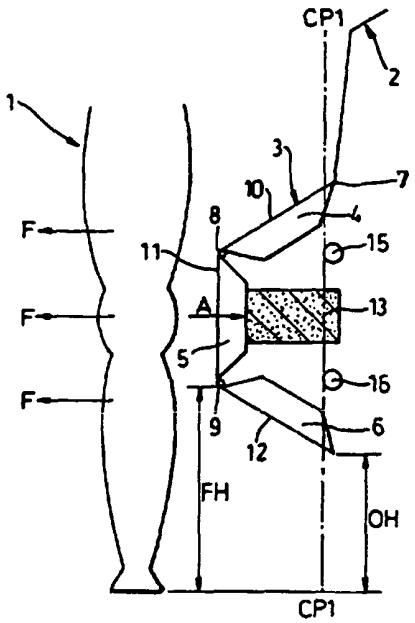

Fig. 1a

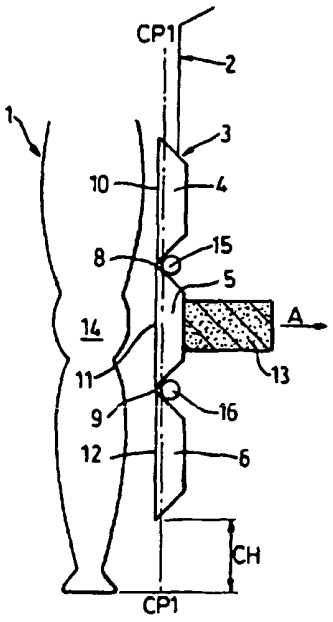

Fig. 1b

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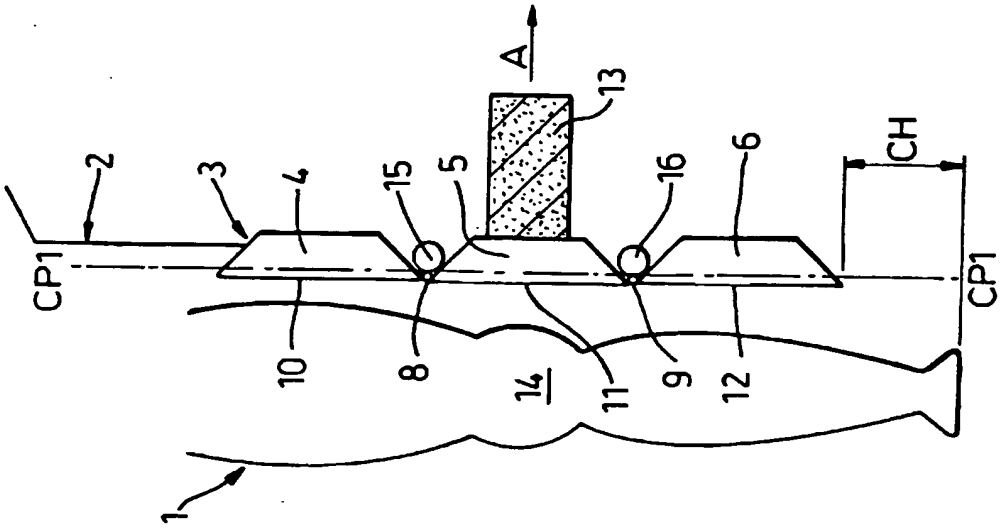

Fig 1b

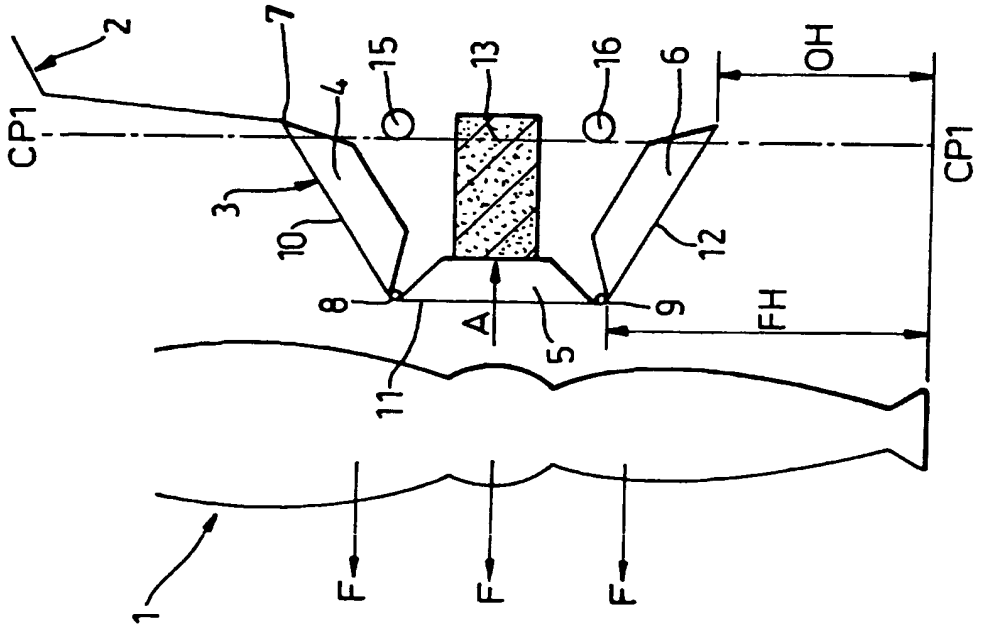

Fig. 1a

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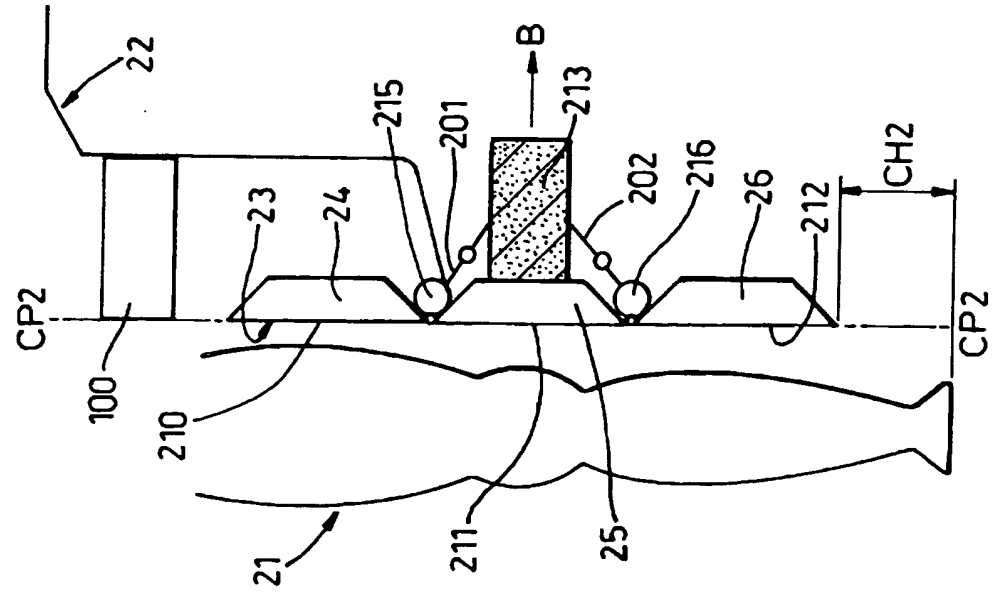

Fig. 2b

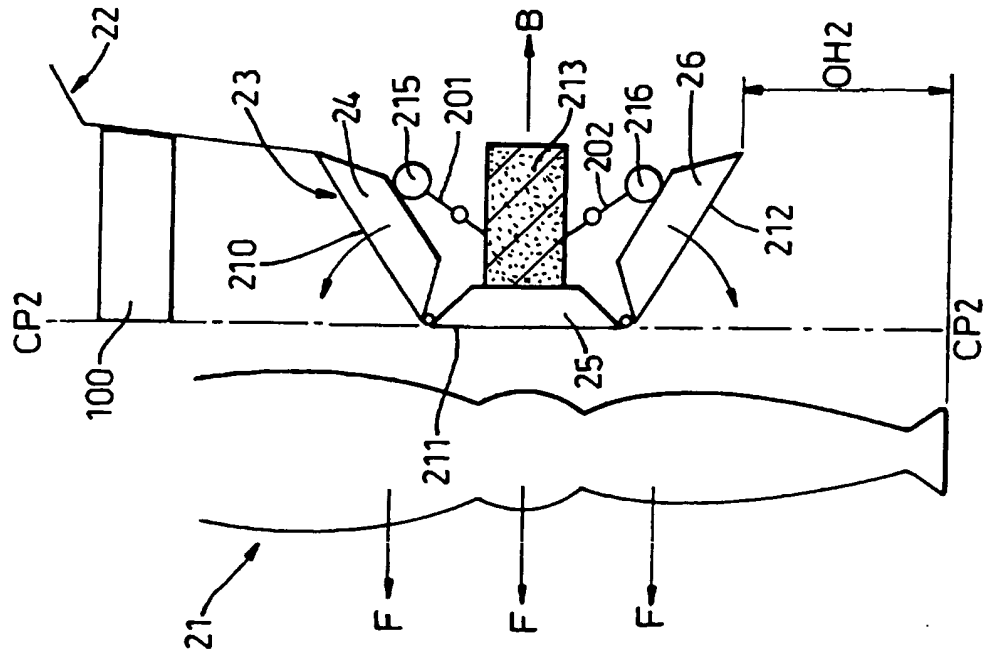

Fig. 2a

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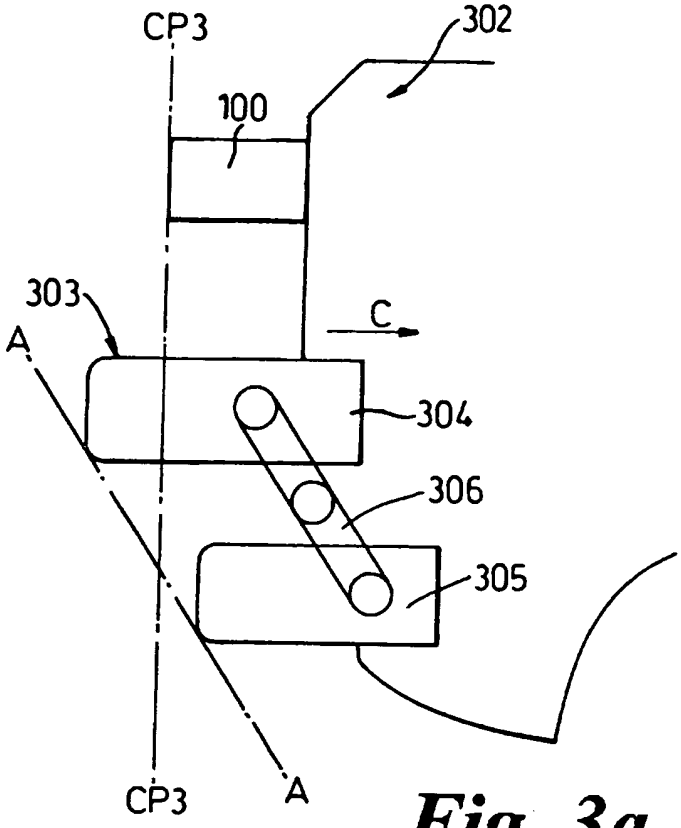

Fig. 3a

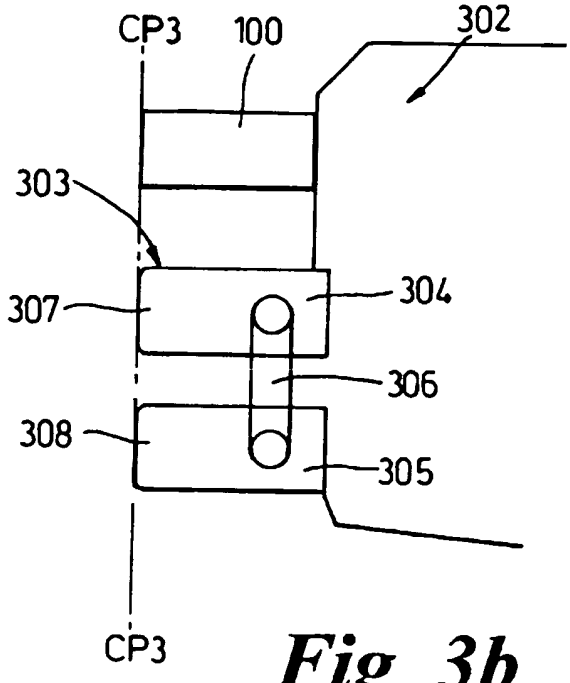

Fig 3b

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BUMPER ARRANGEMENT

The present invention relates to a bumper arrangement for pedestrian safety and more particularly to pedestrian safety with regard to frontal impact with road vehicles.

There is a requirement to continuously improve motor vehicle safety both in terms of vehicle-to-vehicle collisions and with regard to vehicle-to-pedestrian collisions. The present invention relates particularly to collisions between a vehicle, and more especially an off-road 4x4 vehicle, with a pedestrian.

It will be noted that off road vehicles generally have a high ground clearance and approach angle. Thus, such vehicles avoid so-called grounding with rough and uneven terrain.

Such high clearance and approach angles inherently also present a bumper or fender of such a vehicle at a relatively high position upon impact with a pedestrian leg. Thus, when subjected to a collision, that pedestrian's leg is bent in an unacceptable manner. Clearly, any collision between a motor vehicle and a pedestrian will injure that pedestrian. However, by control of the nature of the impact and deformation of the pedestrian, the severity of such injury can be reduced.

Typically, acceptable levels of performance are set by appropriate regulatory authorities through pedestrian safety legislation. Thus, for example, there may be a set limit of 15 degrees to the angle of impact bend between the upper and lower halves of a pedestrian's leg. This set limit may be determined by a test impacter propelled at the front of a motor vehicle at a predetermined velocity, i.e. 40 kph.

A high riding off-road vehicle has difficulty achieving such a set level of pedestrian impact safety due to the high point of contact with the pedestrian's leg. A solution is to provide a bumper contact area for collision with a pedestrian at a lower level and so reduce the impact knee bending angle to an acceptable degree. Unfortunately, with an off road vehicle, it is necessary to retain the approach angle and ground clearance necessary to avoid contact with rough terrain.

In addition to providing a lower contact surface for acceptable pedestrian leg impact performance, it will be appreciated that energy must be adsorbed through such a bumper arrangement. Thus, somewhere in the order of 80 to 100 mm of bumper deformation are required. Modern vehicles include a bumper or fender made from a metal or plastics material which may be sufficiently deformable to absorb pedestrian collision energy when in contact therewith

In an off road vehicle, it will generally be necessary to ensure that there is an approach angle for the bumper in the order of 40°, whilst in an on road situation, the approach angle should be in the order of 15°.

Over recent years, there has been an increase in the use of notionally off road or 4x4 type vehicles for normal highway use. Furthermore, it will be appreciated that due to the indeterminate nature of where contact will take place, it is necessary that the full width of the vehicle is presented for contact in a collision with a pedestrian.

It is an object of the present invention to provide improved pedestrian safety during a collision through by an appropriate bumper arrangement to limit impact leg bend in such a collision.

In accordance with the present invention, there is provided a bumper arrangement for a motor vehicle, the arrangement comprising segmented bumper means coupled together with deformation means therebetween, said segmented bumper means comprising respective bumper components having abutment surfaces presented about a collision plane and said abutment surfaces upon percussive collision being displaced towards said collision plane through displacement of the said bumper components about said deformation means.

The segmented bumper means may comprise a plurality of bumper components angularly presented with respect to each other to form a rebated barrier. Alternatively, the segmented bumper means may comprise bumper components respectively pivoted about a pivot mounting.

The arrangement may include deformation resistance means coupled to the bumper components. The deformation resistance means may present differential deformation resistance between respective bumper components. Such deformation resistance differential between respective bumper components being configured to facilitate or assimilate percussive collision with a pedestrian leg.

Embodiments of the present invention will now be described by way of example only with reference to the accompanying drawings, in which:

Figure 1 illustrates in pictorial schematic side elevation a first embodiment of a bumper arrangement;

Figure 2 illustrates in pictorial schematic side elevation a second embodiment of a bumper arrangement; and

Figure 3 illustrates in schematic side elevation a third embodiment of a bumper arrangement.

As indicated above, the present bumper arrangement reduces the degree of pedestrian leg impact bending as a result of collision contact with a motor vehicle. Thus, the invention has particular applicability to so-called off road 4x4 motor vehicles which inherently have a high bumper location for clearance purposes in rough terrain.

In Figure 1, illustration a depicts a pedestrian leg 1 just prior to collision with a motor vehicle 2 through a bumper arrangement 3. Thus, the bumper arrangement 3 has a functional height FH where the bumper 3 will contact the leg 1 in a collision. In such a collision, the leg 1 will be subjected to deformation forces F in the direction of the arrow heads. Thus, there is a compound deformation between the leg 1 and the bumper arrangement 3 in order to absorb the collision energy created by percussive collision therebetween. The leg 1 will bend whilst the bumper arrangement 3 will crumple and deform during such a collision. It is an object of the present invention to limit the degree of impact bending for the leg 1 to within acceptable levels.

In the embodiment depicted in Figure 1, the bumper arrangement 3 comprises respective bumper components 4, 5, 6. These components 4, 5, 6 are arranged to have an angular presentation with respect to each other to form a rebated channel barrier configuration for the bumper arrangement 3. Thus, the components 4, 5, 6 are secured together about hinge edges 7, 8, 9.

The hinge edge 7 secures a top edge of the arrangement 3 to a motor vehicle 2 in association with other mountings and fastenings (not shown). The hinge edges 8, 9 present the bumper components 4, 5, 6 in an appropriate manner with regard to the vehicle 2. Typically, the hinge edges 8, 9 may comprise a simple cover material secured to respective components 4, 5, 6 through their respective abutment surfaces 10, 11, 12.

The bumper arrangement 3 simply secured through hinges 7, 8, 9 will generally have limited, but if required sufficient, strength to retain their configuration. However, a former element 13 will normally be provided to ensure the rebated panel configuration depicted in Figure 1 is achieved and retained. This former element 13 may be continuous, as with the bumper arrangement 3, across the width of the vehicle or comprise several discrete and separated elements appropriately spaced across the width of the vehicle.

The former element 13 illustrated in Figure 1 is a passive embodiment of the present invention. Thus, the element 13 determines substantially the deformation response of the bumper arrangement 3. The objective is to provide for abutment with the leg 1 over a broad band extending from a relatively low height. Thus, deformation until such a broad abutment surface is achieved should be with little resistance. In such circumstances,

the former element 13 will be easily deformed until broad flat presentation of the arrangement 3 is achieved.

Figure 1b illustrates the passive bumper arrangement 3 with the leg 1 appropriately presented. Some collision energy will be absorbed by deformation of the former element 13 to achieve this relatively flat abutment surface comprising each component 4, 5, 6 and its respective abutment surface 10, 11, 12. Thus, the bumper arrangement 3 presents a bumper to the leg 1 which begins at a height CH from the ground. In such circumstances, it will be appreciated that a broad consolidated abutment surface for collision with the leg 1 is provided and so leg bend under impact, particularly about a knee area 14, is reduced. Typically, it is with the bumper arrangement 3 in this relatively flat configuration that bumper arrangement deformation itself will take place in order to absorb pedestrian and vehicle collision energy.

The present invention is particularly relevant to off road vehicles. Thus, it will be appreciated that the vehicle 2 approach height OH, is retained. However, the lower collision height CH is achieved when collision with a pedestrian occurs. In such circumstances, the off-road performance of vehicle 2 is not radically diminished whilst safety for pedestrians, particularly when the vehicle 2 is operated on a normal highway, is not reduced.

In the passive embodiment depicted in Figure 1, the displacement of the bumper components 4, 5, 6 to the flat configuration depicted in Figure 1b is achieved with little resistance otherwise, contact with the leg 1 will induce undesirable bending of that leg 1. As the hinges 7, 8, 9 will generally be determined such that they provide little resistance to such displacement, it is the former element 13 which retains bumper arrangement 3 configuration for normal operation but allows deformation for impact with a pedestrian. Thus, the former element 13 should readily be displaceable in the direction of arrow head A.

Ready displacement of the former element 13 can be achieved in a number of ways including by providing that the element 13 is easily deformed or easily slid in a slide arrangement or rupturable by some means. Thus, if the former element 13 is made out of an extremely soft material, the bumper arrangement 3 will readily assume the flat configuration depicted in Figure 1b. However, it will be understood that the bumper 3 will generally oscillate as a result of the jolting inherent with vehicle movement. Similarly, if the former element 13 is held within a slide rail or mounting system, the bumper arrangement 3 as perceived from the exterior of the vehicle may wobble, etc. Thus, the former element 13 and associated components will form an assembly which is acceptable and generally equivalent to a current bumper in terms of jolt wobble resistance, etc.

The former element 13 or the whole rebated volume behind the bumper components 4, 5, 6 may be filled with a suitable soft foam to present the bumper arrangement 3 appropriately.

A further alternative for the former element 13 would be a rupturable configuration but this would be inherently a one shot, although resettable, option. Thus, the former element 13 would comprise a bladder or balloon of fluid or gel easily ruptured upon contact with a relatively low force upon abutment surface 11. These bladders or balloons of fluidic material would burst allowing the bumper components 4, 5, 6 to readily deform into the flat configuration depicted in Figure 1b.

It will be appreciated that the objective of the present invention is to provide an abutment surface, substantially flat, which is consistent with a collision plane CP1 as depicted in Figure 1. In Figure 1a, the bumper components 4, 5, 6 are angularly presented to the collision plane CP1. However, after appropriate displacement of these components 4, 5, 6 and the former element 13, the bumper arrangement 3 substantially provides, through respective abutment surfaces 10, 11, 12, a consolidated abutment surface consistent with the collision plane CP1. The collision plane CP1 will typically be perpendicular to a ground surface upon which the vehicle 2 is located in order to present itself to a pedestrian's leg 1.

Once this flat and consistent abutment surface of the bumper arrangement 3 is achieved, it is important that further deformation is resisted to prevent uneven pedestrian energy dissipation. Thus, the bumper arrangement 3 will be retained in its perpendicular configuration through bolster bars 15, 16. These bolster bars 15, 16 prevent further displacement of the bumper arrangement 3 and so bending of the pedestrian's leg 1. As depicted in Figure 1, these bolster bars 15, 16 are arranged to act about the hinge positions 8, 9 of the bumper arrangement 3. However, alternative positions can be used provided such bolster bars 15, 16 do not inhibit or restrain deformation to the desired consistency with the collision plane CP1. The bolster bars 15, 16 are robustly mounted within the vehicle 2 consistent with the crumple zones and for coupling to those zones during vehicle to vehicle collisions.

Typically, the bumper components 4, 5, 6 will be made from a plastics material and comprise beams which extend across the width of the vehicle 2. However, it will be understood that the bumper components 4, 5, 6 could be segmented across the width of the vehicle 2. Furthermore, the deformation response of each respective bumper component 4, 5, 6 could be separately tuned to achieve the most acceptable presentation of the bumper arrangement 3 to a pedestrian leg 1 during a collision. Thus, the upper bumper component 4 along with the lower bumper component 6 could be arranged to be more robust than the central bumper component 5. In such

circumstances, there may be a more rapid displacement to that consistent with the collision plane CP1 configuration depicted in Figure 1b along with collision energy dissipation.

The passive embodiment depicted in Figure 1 may be inappropriate within some vehicles due to the inherent slight delay in assuming a flat configuration. There may also be denting in the bumper arrangement 3 as a result of harsh treatment. Thus, Figure 2 illustrates a first reactive embodiment of the present invention.

In Figure 2 a bumper arrangement 23 having a similar cross-sectional configuration to that depicted in Figure 1 is illustrated. Thus, a pedestrian's leg 21, upon collision with a vehicle 22, is first contacted by the bumper arrangement 23. However, unlike with regard to Figure 1, the bumper arrangement is reactive. Thus, a collision sensitive element 213 is arranged to propel an upper bumper component 24 and a lower bumper component 26 to assume a co-planar configuration with a central bumper component 25. The bumper components 24, 25, 26 will normally present their flat abutment surfaces 210, 211, 212 to be consistent with a collision plane CP2.

In the example depicted in Figure 2, the collision sensitive element 213 acts by propelling respective upper and lower roller elements 215, 216

forwards in the direction of the pedestrians leg 21. Such propulsion forces respective bumper components 24, 26 into alignment with the collision plane CP2. The collision sensitive element 213 is coupled to respective rollers 215, 216 through respective coupling rods 201, 202. These rods 201, 202 are centrally pivoted. Thus, lateral movement in the direction of arrow head B will act about the central pivots to push the rollers 215, 216 forwards. This movement presents the bumper components 24, 26 appropriately. Thus, the collision sensitive element 213 includes appropriate means to achieve such lateral movement in the direction of arrow head B. These means may induce slide under collision force or be driven by pyrotechnic propulsion means.

A collision by the vehicle 22 upon a pedestrian's leg 21 presents force F in the direction indicated by arrow heads upon that leg 21. In accordance with the embodiment depicted in Figure 2, the collision sensitive element 213 rapidly detects such a collision. Thus, by appropriate means as indicated above, acts through the rods 201, 202 to propel the bumper elements 24, 26 into alignment with the central bumper element 25. This creates a consistent collision barrier to the leg 21 along the collision plane CP2. Thus, the forces F from the vehicle 22 are presented to the leg 21 as depicted in Figure 2b, in a relatively wide band which extends from a low height CH2 above the ground. In such circumstances, bending of the leg 21 is reduced and so the extent of injury to the leg 21.

The bumper arrangement 23 when not deployed, and as depicted in Figure 2a, has a sufficient operational height OH2 for clearance purposes in terms of off road use of the vehicle 22.

A major distinction between the embodiments depicted in Figure 1 and 2 is that the bumper arrangement 23 is generally more robust before deployment. Thus, the arrangement 23 is potentially more acceptable for the conditions inherent in off road vehicle use. However, care must be taken to ensure that rapid and violent propulsion of the arrangement 23 does not precipitate additional injury to a pedestrian.

Figure 3 illustrates a further reactive embodiment of the present invention. A vehicle 302 includes a bumper arrangement 303. The bumper arrangement 303 comprises an upper bumper component 304 and a lower bumper component 305 coupled together through a pivot arm 306. The pivot arm 306 is essentially pivoted to the bumper components 304, 305 and to a position intermediate these components 304, 305.

Figure 3a depicts the bumper arrangement 303 in its normal vehicle operational state. Thus, the bumper components 304, 305 are located in a staggered configuration either side of a collision plane CP3. In such a configuration, it will be appreciated that there is adequate approach angle A-A for the vehicle 302 due to the staggered arrangement of the components

304, 305 for effective use in off road situations. Such an approach angle is depicted by broken line A-A.

During a collision, the upper bumper component 304 first contacts a pedestrian and so is depressed in the direction of arrow head C. Thus, through the action of arm 306 about the central pivot, the lower bumper component 305 is projected forwards.

As depicted in Figure 3b, the upper bumper component 304 and the lower bumper component 305 are arranged to present respective abutment surfaces 307, 308 which are consistent with a collision plane CP3. In such circumstances, a broad contact surface is provided to the pedestrian. Furthermore, this contact surface is from a reduced height above ground in comparison with the displaced configuration depicted in Figure 3a. Thus, in accordance with the rational described above, the potential impact bend of a pedestrian leg in contact with the bumper arrangement 303 is reduced along with the extent of collision injuries caused to that pedestrian.

Those skilled in the art will appreciate that lateral displacement in the direction of arrow head C by the upper bumper component 304 should be easily achieved at relatively low force in order to allow easy displacement between normal, highway configuration and a displaced, off-road configuration. Thus, typically the upper bumper component 304 may be

displaceable through hand pressure but biased forwards into the configuration depicted in Figure 3a. Resistance to movement may be altered in accordance with driving conditions, i.e. between off road and highway under control of a vehicle driver or automatically through a control monitor system of the vehicle.

It will be appreciated by those skilled in the art that the above embodiments are only for description in order to appreciate and understand the present invention. Thus, alternative embodiments may be devised which are in accordance with the present invention.

It will be appreciated that the bumper arrangement will absorb most pedestrian energy in a collision. Thus, the bumper components should be made from appropriately deformable materials. However, in collision with more substantial objects, such as other vehicles or stationary obstructions, i.e. trees, walls, etc., the bumper arrangement should be coupled to existing crumple zones, crush boxes, etc. of the vehicles in order to absorb the energy of such collisions.

It will be understood to further extend upwards the collision plane CP with a pedestrian, further fixed protrusions 100 could be added to a vehicle with a surface consistent with the collision plane CP.

CLAIMS

1. A bumper arrangement for a motor vehicle, the arrangement comprising segmented bumper means coupled together with deformation means therebetween, said segmented bumper means comprising respective bumper components having an abutment surface presented about a collision plane and said abutment surfaces upon collision being displaced towards said collision plane through displacement of said bumper components about said deformation means.

2. A bumper arrangement as claimed in Claim 1, wherein the segmented bumper means comprises a plurality of bumper components angularly presented with respect to each other along respective edges thereof to form a rebated barrier and said deformation means being hinges formed between said respective edges.

3. A bumper arrangement as claimed in Claim 1, wherein the segmented bumper means comprises bumper components respectively arranged in parallel planes with said deformation means being a pivot arm therebetween.

4. An arrangement as claimed in any preceding claim, wherein the arrangement includes deformation resistance means in order to vary

the respective deformation response of each bumper component when a percussive collision is presented to the bumper arrangement.

5. A bumper arrangement as claimed in Claim 4, wherein the deformation resistance means is coupled to each respective bumper component.

6. A bumper arrangement as claimed in Claim 4 or Claim 5, wherein the deformation resistance means comprises a deformable component or a rupturable component or a slideable component held within slide rail means in order to ensure that the bumper arrangement is appropriately configured until a percussive collision is presented to the bumper arrangement in use.

7. A bumper arrangement substantially as hereinbefore described with reference to Figure 1.

8. A bumper arrangement as hereinbefore described with reference to Figure 2.

9. A bumper arrangement substantially as hereinbefore described with reference to Figure 3.

10. A motor vehicle including a bumper arrangement as claimed in any preceding claim.

The Patent Office

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Application No:	GB 9908264.6	**Examiner:**	Paul Gavin
Claims searched:	All	**Date of search:**	25 August 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): B7B(BSBNC,BSEB)

Int Cl (Ed.6): B60R(19/04,12,14,24,38,40, 21/34)

Other: Online : WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
On file	GB2 321 624 A	(LIN PAC) - Consider especially p6 line18 to p7 line31 & Figs. 3 & 4.	1,3,4 & 10
On file	GB 2 069 940 A	(DAIMLER-BENZ) - Consider especially p 3 lines 32-40.	
On file	US 4 015 870	(RENAULT) - Consider especially Figs 1 & 2	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.